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IS 10247 (1982): Method of determination of impact index
[MED 17: Chemical Engineering Plants and Related Equipment]

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IS : 10247 - 1982

(Reaffirmed 2006)

Indian Standard

METHOD OF DETERMINATION OF IMPACT INDEX

1. Scope — Covers the methods of determination of impact index for size reduction by impact.

2. Definition

2.1 *Impact Index* — It is a measure of resistance of a material to crushing when subjected to a sudden impact load. The absolute impact index cannot be measured either by direct or indirect measurements. However, relative impact index can be measured by following method.

3. Details of Equipment — It shall consist of a steel crushing mortar fitted at the base of a long detachable steel cylinder, which guides a freely falling weight (Fig. 1). At the beginning the weight shall hang at the top end of the grinding cylinder (above the base) by means of hook from which the weight shall be released at will to let it drop and crush the material placed in the mortar. A brass wire, hooked at one end, shall be used to raise the weight dropped in the mortar. After every drop, the bottom of the mortar shall be scrapped.

IS sieves of 2·8 mm and 1·7 mm apperture sizes shall be used for the preparation of the feed and 1·0 mm, 500 μm, 212 μm, 150 μm and 75 μm apperture size shall be used for analysis of the product.

A mechanical sieve shaker with time switch arrangement shall be used to shake the sieves for 15 minutes every time. For measurement of accurate weights, a chemical balance measuring up to second place of decimal shall be used.

4. Impact Index — Rittinger's number denotes the mechanical energy required for creating a new surface when the material is being crushed. The valves for different materials depending on the elastic constant and their relation to the ultimate strength and on the manner or rate of application of the crushing force.

According to Rittinger's Law

$$E = K_r (A_2 - A_1) \ldots\ldots \ldots\ldots (1)$$

where E is the energy consumed in the process in kg.cm A_1 and A_2 are the initial and final surface area of the feed and the product particles respectively in cm^2 and K_r is the Rittinger's index in $\frac{\text{kg. cm}}{(\text{cm})^2}$.

In the case of impact crushing:

$$E = n.\ mgh \ldots\ldots \ldots\ldots (2)$$

where n is the number of drops of the steel cylinder,

m is the weight of the steel cylinder in kg,

g is the acceleration due to gravity cm/s^2, and

h is the height through which the steel cylinder falls in cm.

From (1) and (2) :

$$n = \frac{K_r (A_2 - A_1)}{mgh}$$

If a plot is made of n versus (A_2-A_1), fresh surface created, a straight line is obtained. From the slope K_r can be calculated.

5. Test Procedure — The feed shall be prepared by crushing the material in the drop weight apparatus to pass through 2·8 mm apperture size. The fraction retained on 1·7 mm shall be taken. One hundred grams of this feed shall be taken in thoroughly cleaned mortar. The cylinder is set in position, the weight is hung from the releasing hook and released to drop and crush the feed.

The cylinder shall be allowed to fall freely the hook 5 times on the sample uniformly distributed on the base of the mortar. The material shall be taken out and sieved with sieves sizes 1·7 mm, 1·0 mm, 500 μm, 212 μm, 150 μm and 75 μm.

Chemical Engineering Sectional Committee, EDC 57; Crushing & Grinding Equipment Subcommittee, EDC 57 : 4 [Doc : EDC 57 (3522)]

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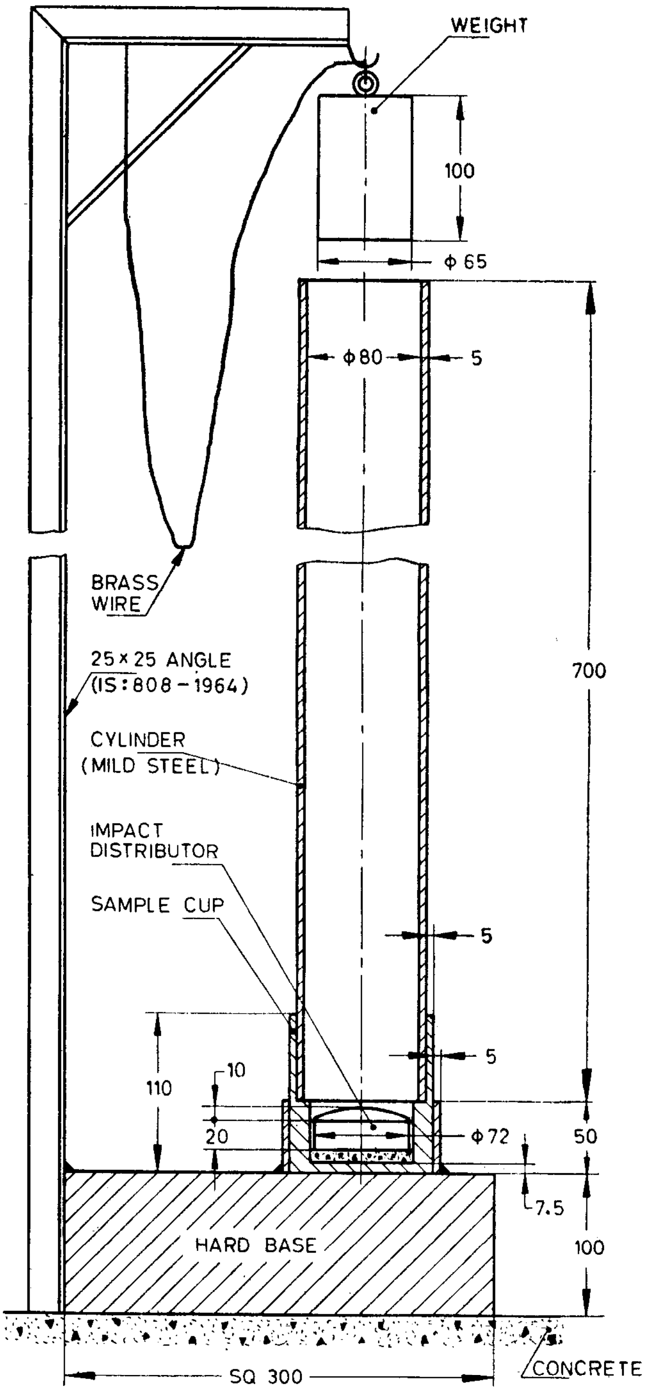

All dimensions in millimetres.

FIG. 1 DROP WEIGHT CRUSHER

5.1 The material retained on each sieve shall be weighed up to second place of decimal. Tabulate the results as shown in Table 1. The procedure shall be repeated with fresh samples with 10, 15, 20 and 25 number of drops.

5.2 The fresh surface created shall be calculated for different number of drops as shown in Table 2.

5.3 A curve shall be plotted on rectangular co-ordinates of number of drops n versus fresh surface created ($A_2 - A_1$). The slope shall be measured and the results tabulated as shown in Table 3 to determine the Rittinger's Index K_r or the drop weight impact index $\frac{1}{K_r}$.

TABLE 1 SURFACE AREA OF CRUSHED MATERIAL

(*Clause* 5.1)

No. of drops : 5

Apperture Size	Av. Diameter D_p* cm	Shape Factor †η	Specific Surface $\frac{\eta}{D_p}$	Mass Fraction m	Area of the Fraction $m \times \frac{\eta}{D_p}$
Total					

* $D_p = \frac{d_1 + d_2}{2}$ where,

d_1 = size in micron of apperture of passing sieve, and

d_2 = size in micron of apperture of retaining sieve.

† η = Actual surface/surface calculated on the basis of spherical particles.

Specific surface $= \frac{\eta}{D_p}$

TABLE 2 FRESH SURFACE CREATED FOR VARIOUS NUMBERS OF FALLS

(*Clause* 5.2)

No. of Drops of Free Fall	Surface Area Feed A_1	Surface Area Product A_2	Fresh Surface Created ($A_2 - A_1$)

TABLE 3 DETERMINATION OF DROP WEIGHT IMPACT INDEX

(*Clause* 5.3)

Sl. No.	Parameter	Value
1	Density of material kg/m^3	kg/m^3
2	Fresh surface area created per drop ($A_2 - A_1$) cm^2	m^2
3	Weight of drop (2 to 3 kg) kg	kg
4	Height of drop (0·5 to 1 m) cm	cm
5	Work per drop kg.cm	kg.cm
6	Slope	
7	Rittinger's index (cm)^2/kg.cm	(cm)^2/kg.cm
8	Drop weight impact index kg.cm/(cm)^2	kg.cm/(cm)^2

EXPLANATORY NOTE

The impact index of a material reflects the power requirement to crush the material by subjecting it to a sudden load.

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